CLIMATE SERVICES for wind energy

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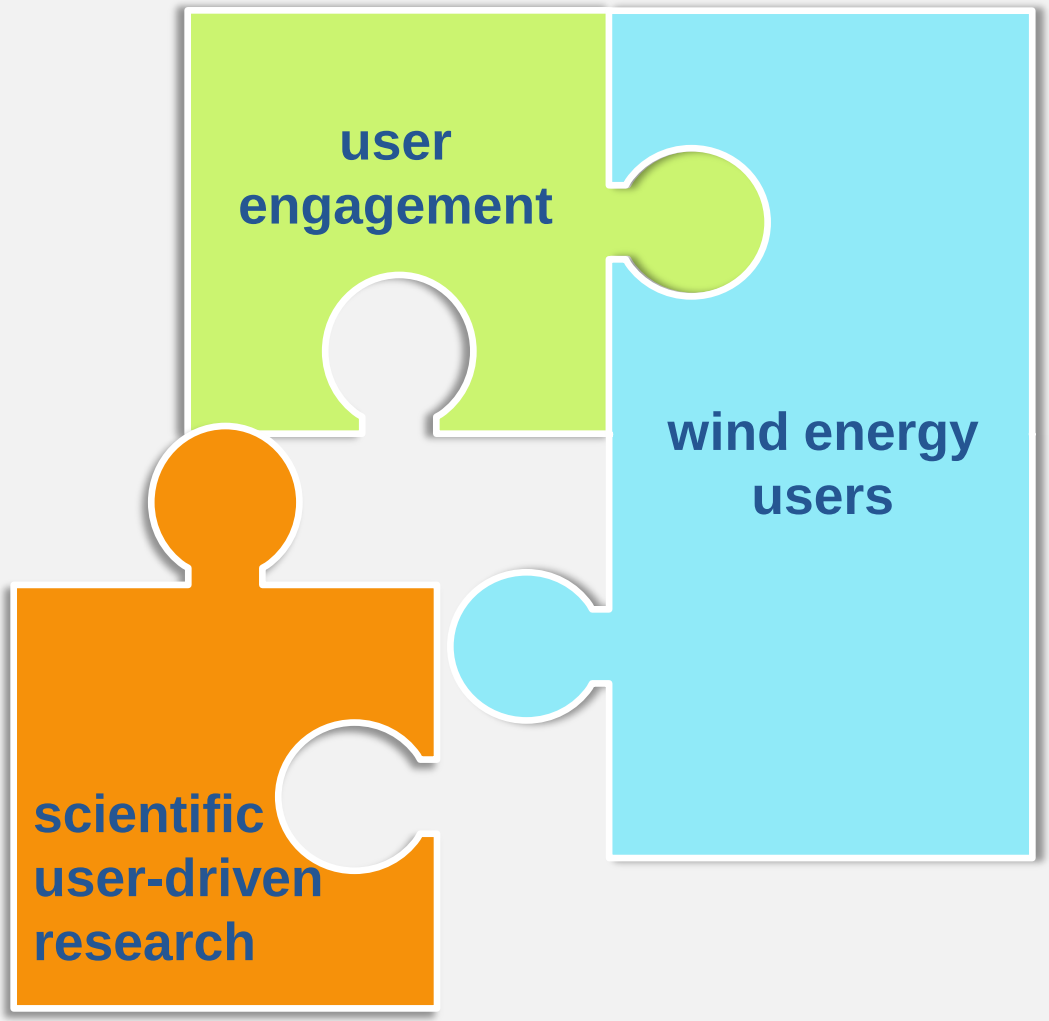
Centro Nacional de Supercomputación
EXCELENCIA SEVERO OCHOA



HOW EL NIÑO CAN BE USED TO IMPROVE WIND SPEED SEASONAL PREDICTABILITY?

Nube Gonzalez-Reviriego (1), Raül Marcos (1), Francisco J. Doblas-Reyes (1,2), Verónica Torralba (1), Nicola Cortesi (1), Doo Young Lee (1) and Albert Soret (1)

1 Barcelona Supercomputing Center (BSC), Barcelona, Spain
2 Institució Catalana de Recerca i Estudis Avançats (ICREA), Barcelona, Spain

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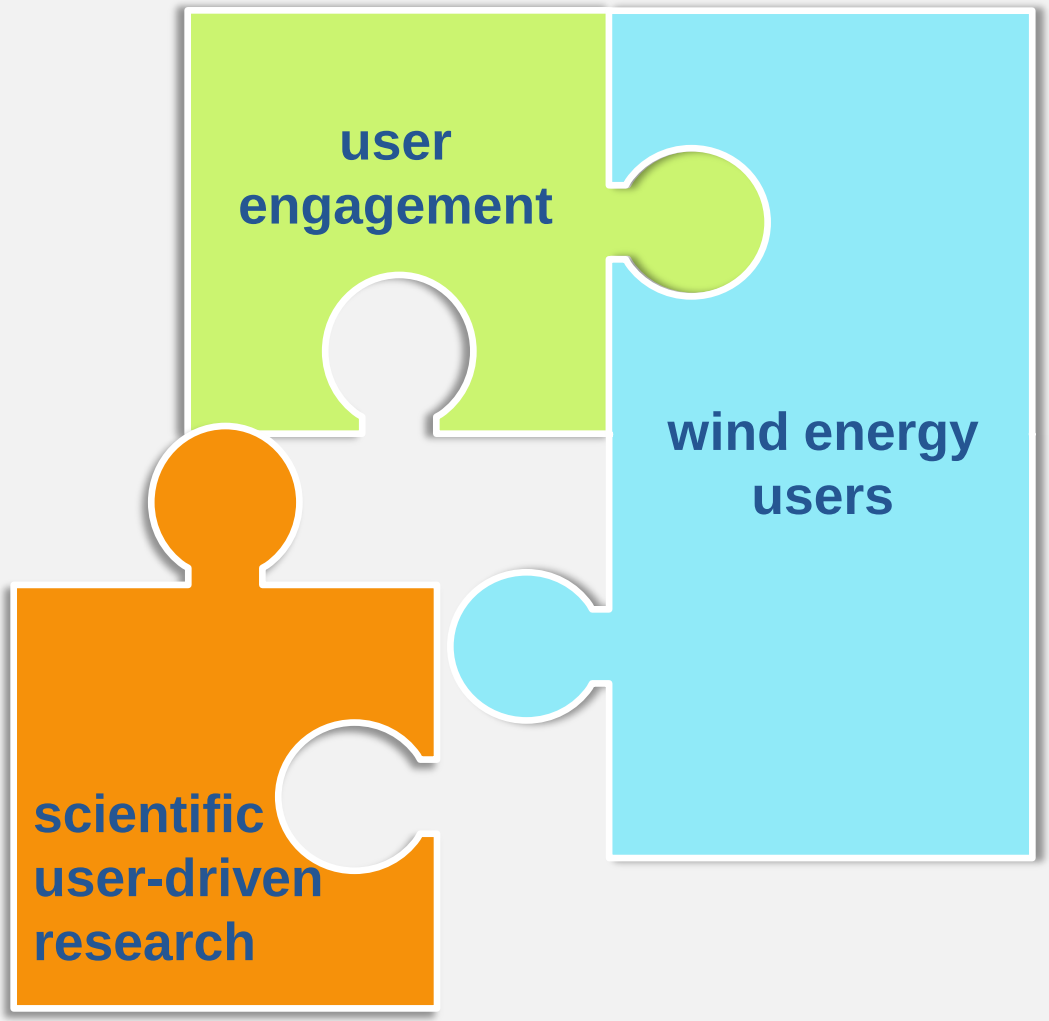

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Scientific user-driven research

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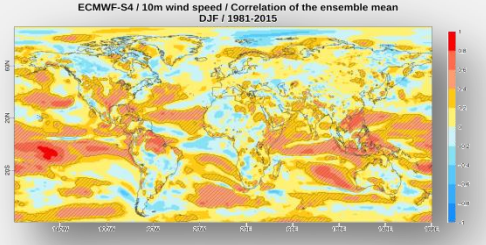
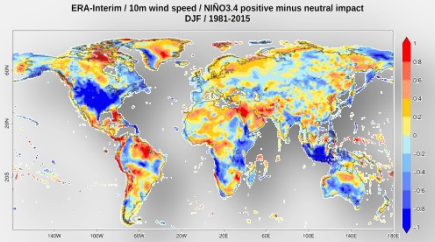
EXCELENCIA SEVERO OCHOA

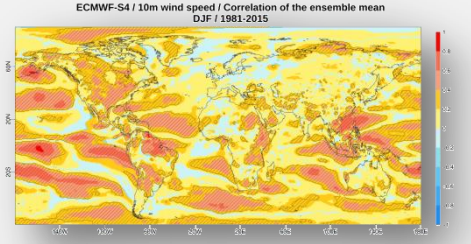
Specific user question: lack of wind speed skill

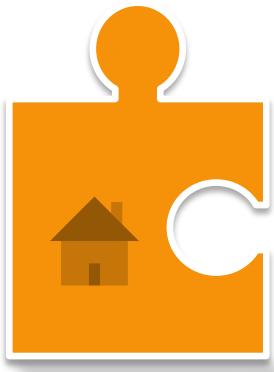


How scientific research can help?

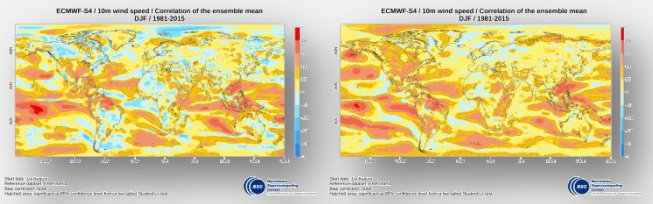


Improving wind speed skill

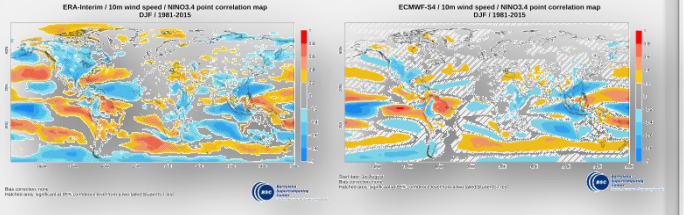




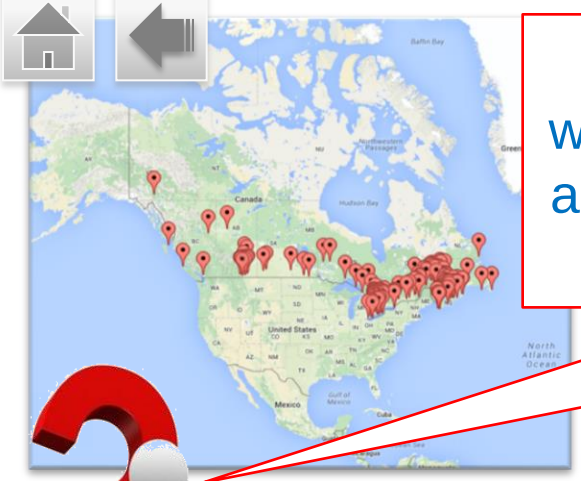
Before and after improving wind speed skill



Why does wind speed skill improve?



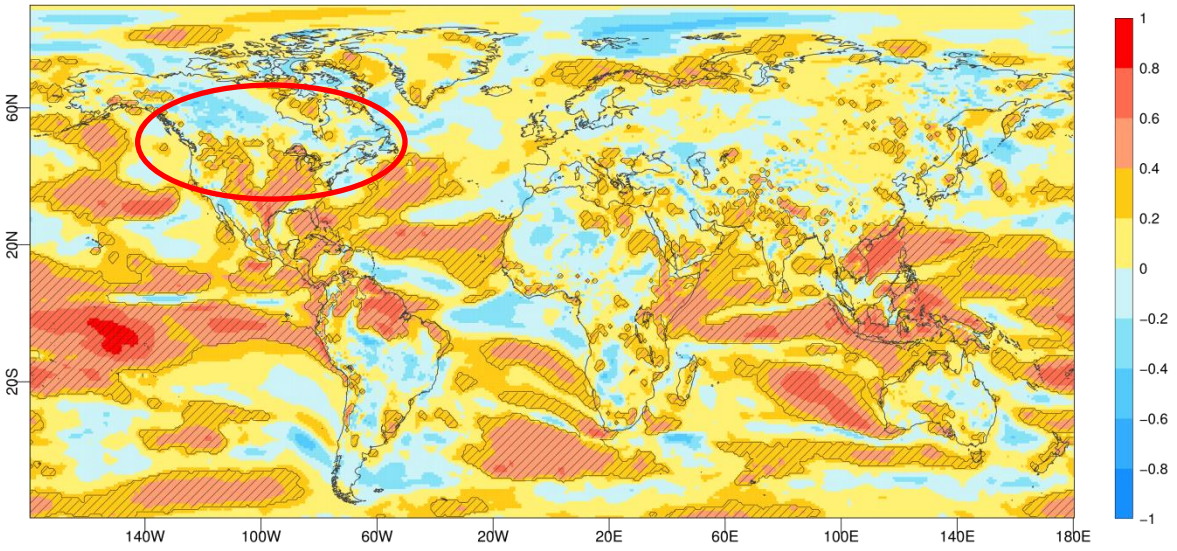
Specific user question: lack of wind speed skill



User

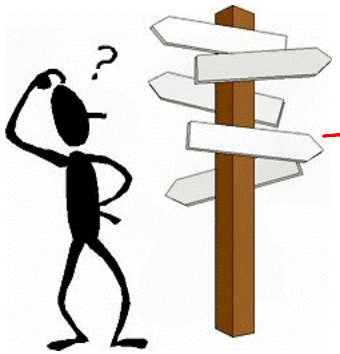
I would like to know the prediction of the next winter wind speed over my wind farms in Canada 4 months in advance. Nevertheless, I realized that there is very low or no skill there

ECMWF-S4 / 10m wind speed / Correlation of the ensemble mean
DJF / 1981-2015



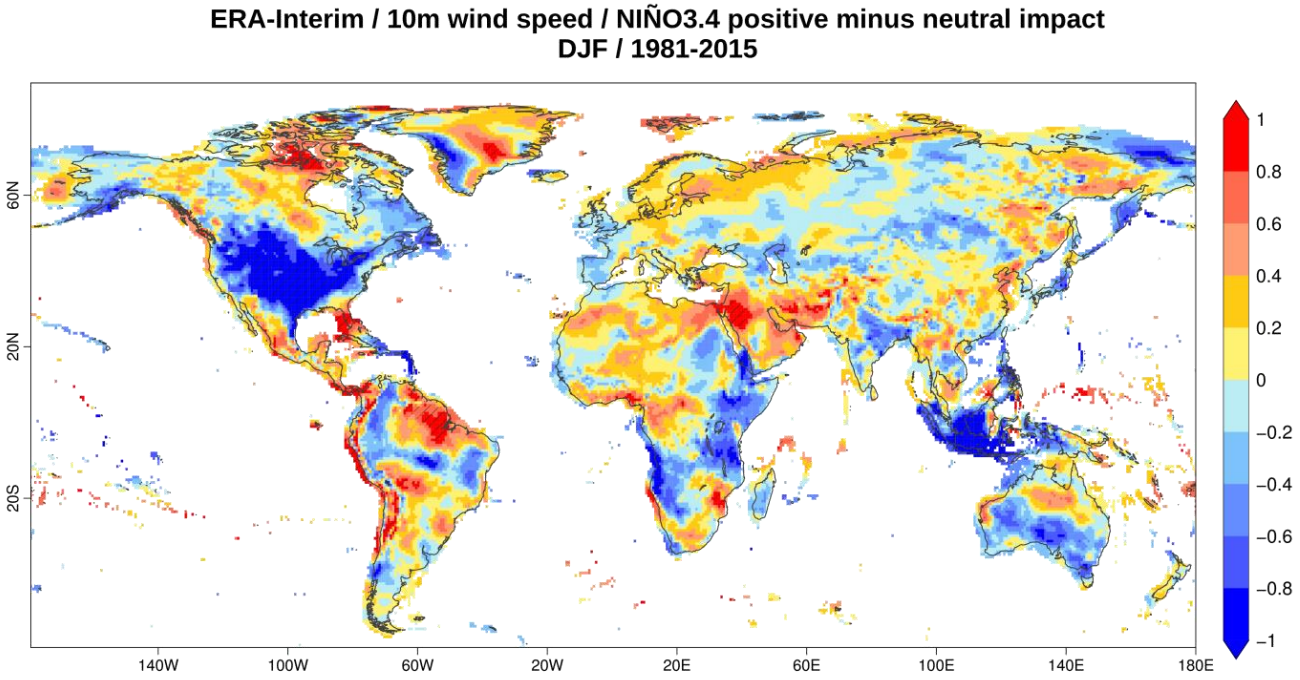
Start date: 1st August
Reference dataset: ERA-Interim
Bias correction: none
Hatched area: siginficant at 95% confidence level from a two tailed Student's t-test

How scientific research can help?



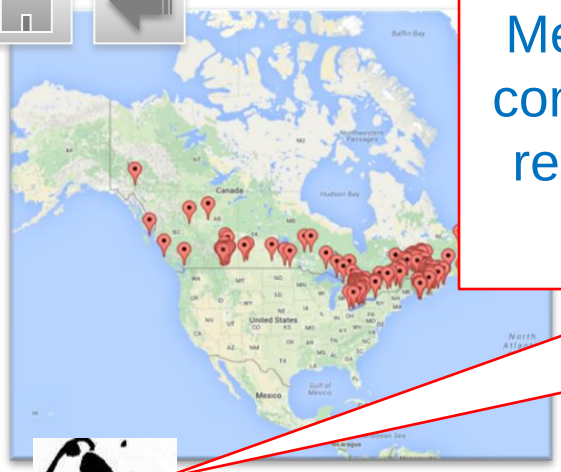
Scientist

Looking for sources of predictability to improve seasonal wind speed predictions: observed El Niño 3.4 index and its impact on wind speed.



Bias correction: none
Hatched area:siginficant at 95% confidence level from a two tailed Student's t-test
Mask: sea depth below 50m

Improving wind speed skill

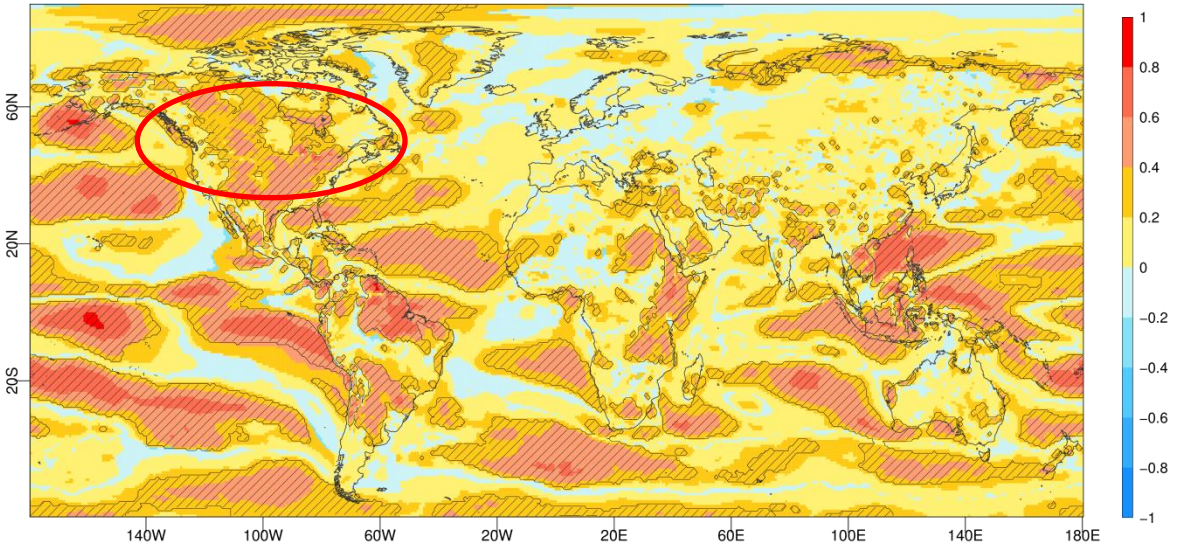


Method to obtain a more skillful wind speed predictions: combining the information obtained from (i) the observed relationship between El Niño index and the wind speed and (ii) seasonal predictions of El Niño index

Technical details

Scientist

ECMWF-S4 / 10m wind speed / Correlation of the ensemble mean
DJF / 1981-2015



Start date: 1st August
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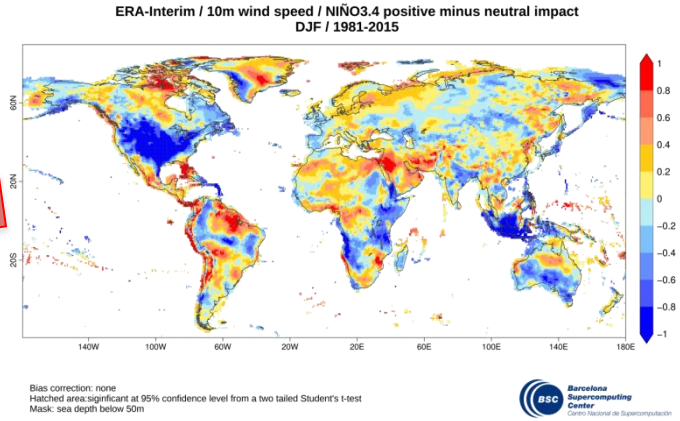
Improving wind speed skill

Methods



W_{obs}: Observed wind speed

Ind_{obs}: Observed NIÑO 3.4 index

i: year of the season

$$W_{obs_i} = a_i \times Ind_{obs_i} + b_i$$

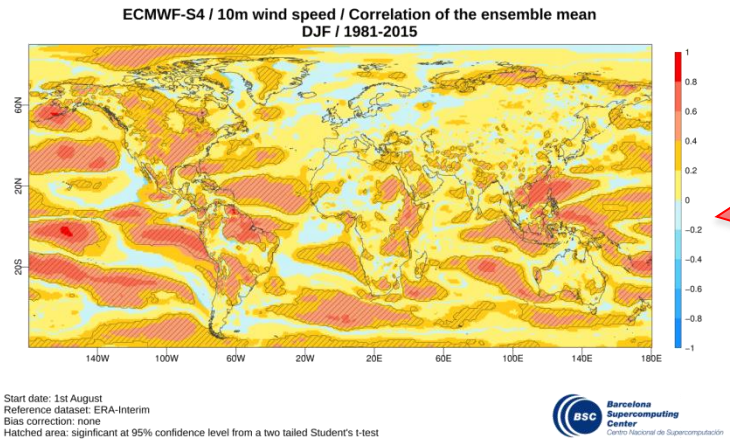
$$W_{frc_{ij}} = a_i \times Ind_{frc_{ij}} + b_i$$

W_{frc}: Predicted wind

Ind_{frc}: Predicted NIÑO 3.4 index

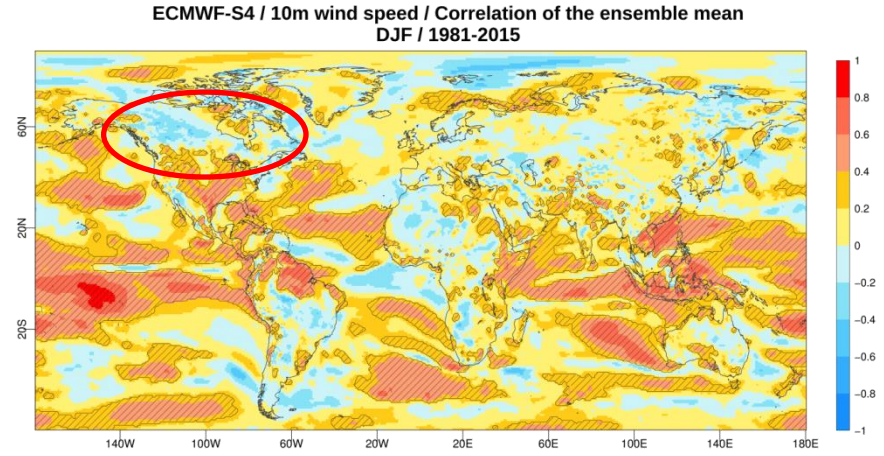
i: year of the season

j: lead time



Before and after improving wind speed skill

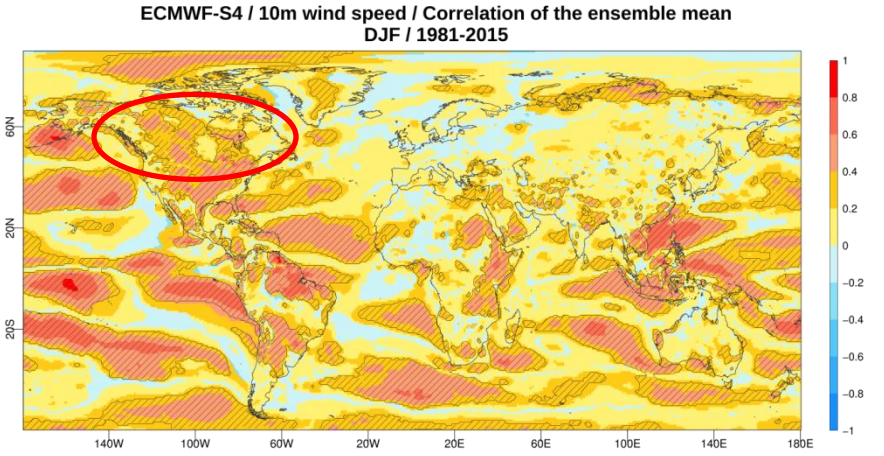
Before



Start date: 1st August
Reference dataset: ERA-Interim
Bias correction: none
Hatched area: siginficant at 95% confidence level from a two tailed Student's t-test

10m wind speeds for DJF season obtained from ECMWF S4 seasonal predictions started on 1st August

After



Start date: 1st August
Reference dataset: ERA-Interim
Bias correction: none
Hatched area: siginficant at 95% confidence level from a two tailed Student's t-test

10m wind speeds for DJF season obtained from El Niño 3.4 index predicted with ECMWF S4 forecast system. Start date 1st August

Improvement of wind speed skill over Canada

Why does wind speed skill improve?

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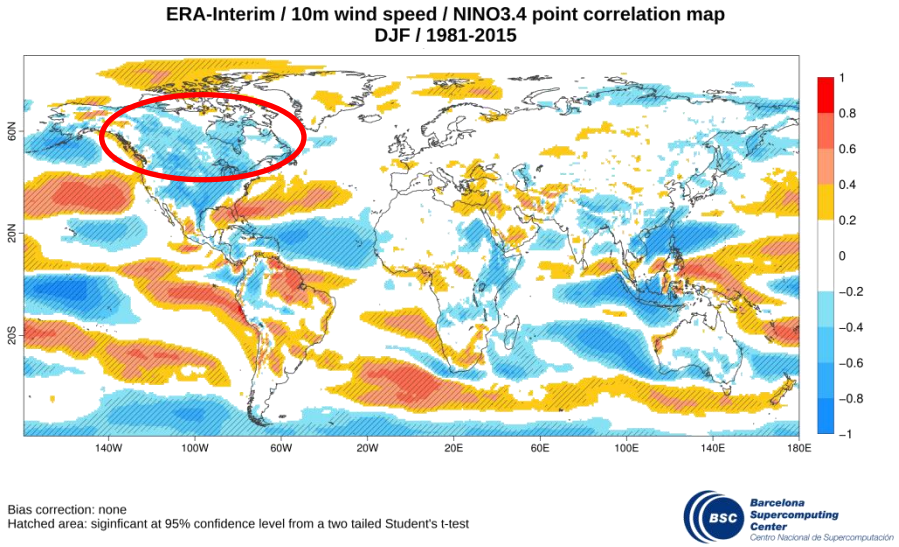
The impact of El Niño 3.4 index on 10m wind speeds for DJF season over the period 1981-2015 is different from observations (ERA-Interim) and predictions (ECMWFS4) over Canada

ERA-Interim



Bias correction: none
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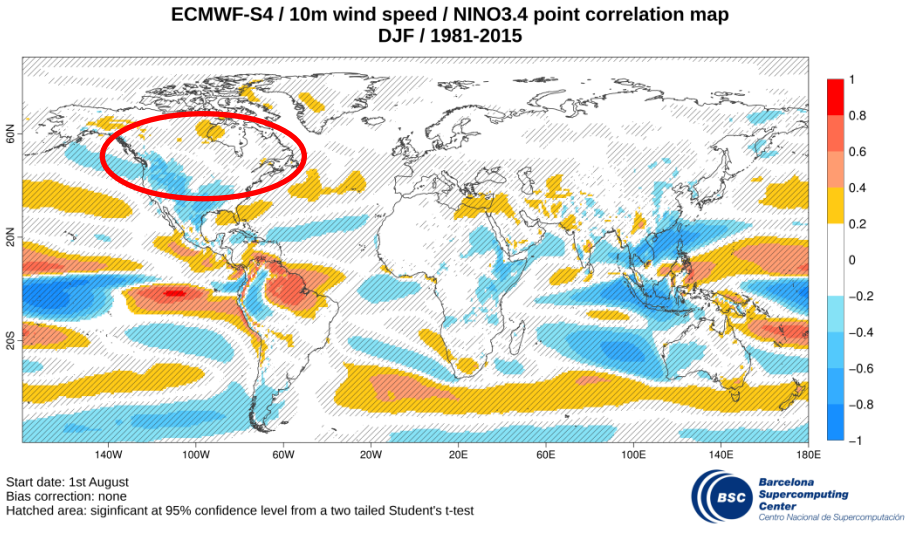
ECMWF S4



Start date: 1st August
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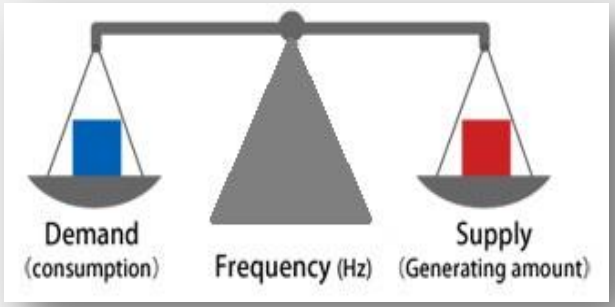
The method for improving wind speed skill uses the observed impact of El Niño on wind speed whereas the ECMWF S4 is not able to reproduce it correctly over some areas such as Canada

Wind energy users

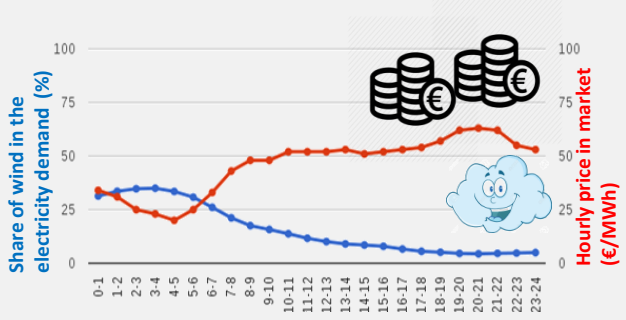
Maintenance works

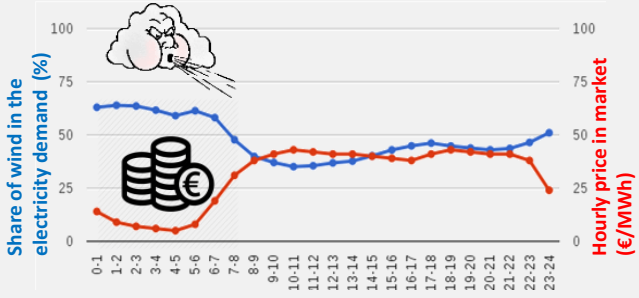
Grid management



Financial operations

Share of wind power supply and hourly price evolution

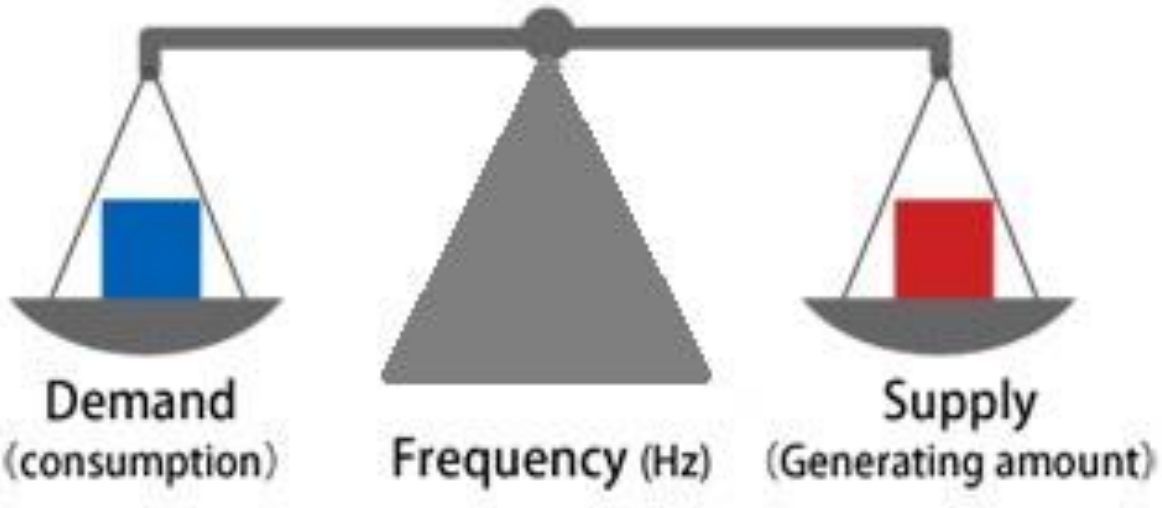




Maintenance works

Maintenance should be performed during less windy periods in order to minimise the risk of storms and swell conditions. For that reason estimating wind energy resources at seasonal time scales can be useful for the schedule of this works, particularly in offshore wind farms.

Grid management



Seasonal predictions of wind resources can potentially benefit grid operators and allow them to adapt the electric network to wind power supply. Supply and demand are the determining factors for the market and important decisions must be made in order to attain adequate load balancing between production and consumption.

Financial operations

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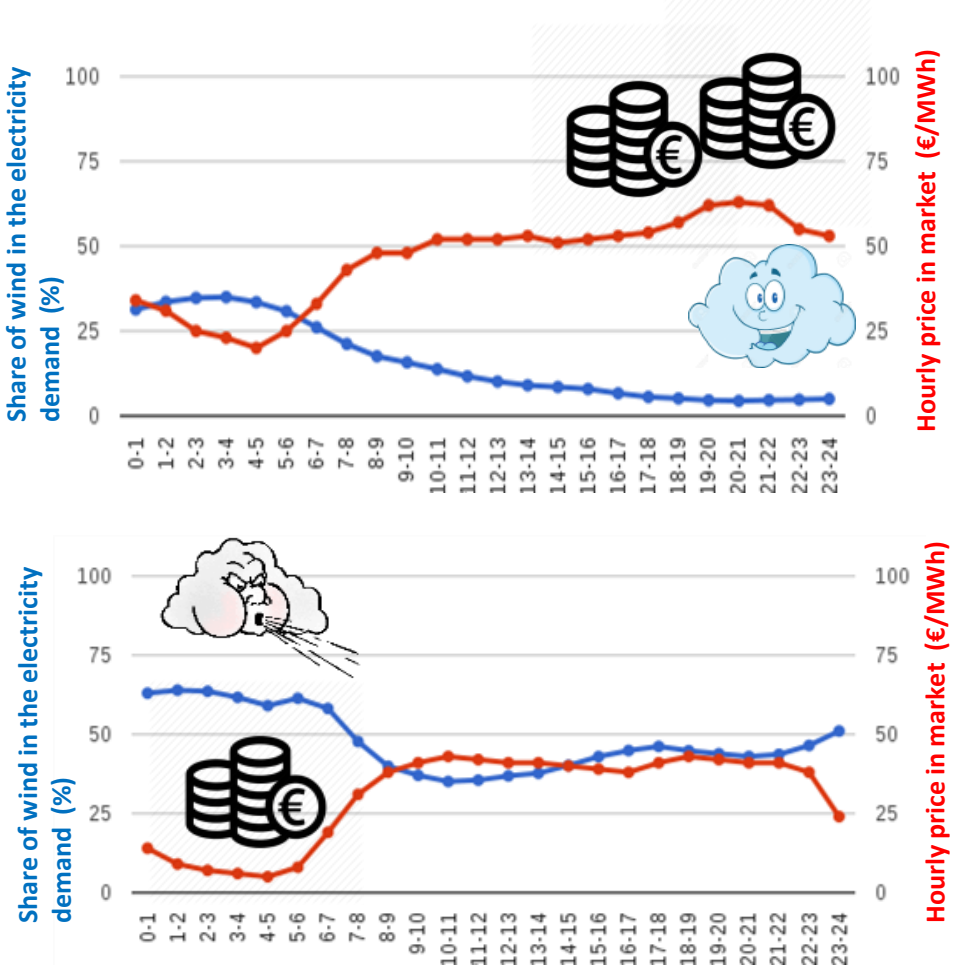
Share of wind power supply and hourly price evolution



For the financial teams running the wind farm business having a budget of the energy they will produce in the coming months is of crucial importance, because this information can be used to anticipate cash flow and this can be translated in important cost savings.

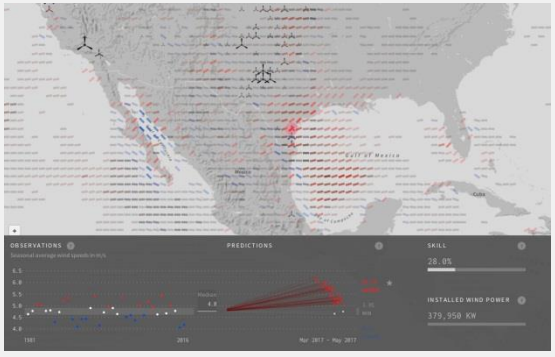
User engagement

User Interface Platform

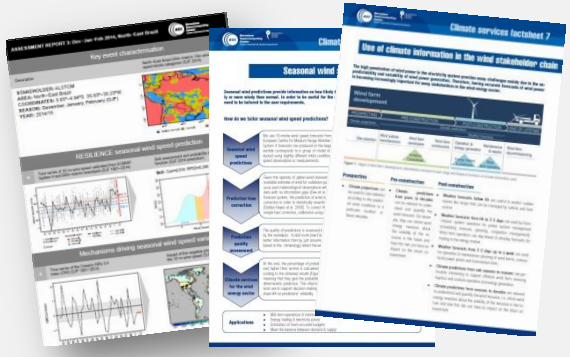
AReCS
Advancing Renewable Energy with Climate Services

http://www.bsc.es/ESS/arecs

RESILIENCE wind prototype



Factsheets/Case studies



Apps

ARECS User Interface Platform

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Home » Our Services » Climate Services » ARECS » Advancing Renewable Energy with Climate Services

ARECS
Advancing
Renewable Energy
with Climate Services

On-line User Interface Platform for energy users

ICON ATTRIBUTION

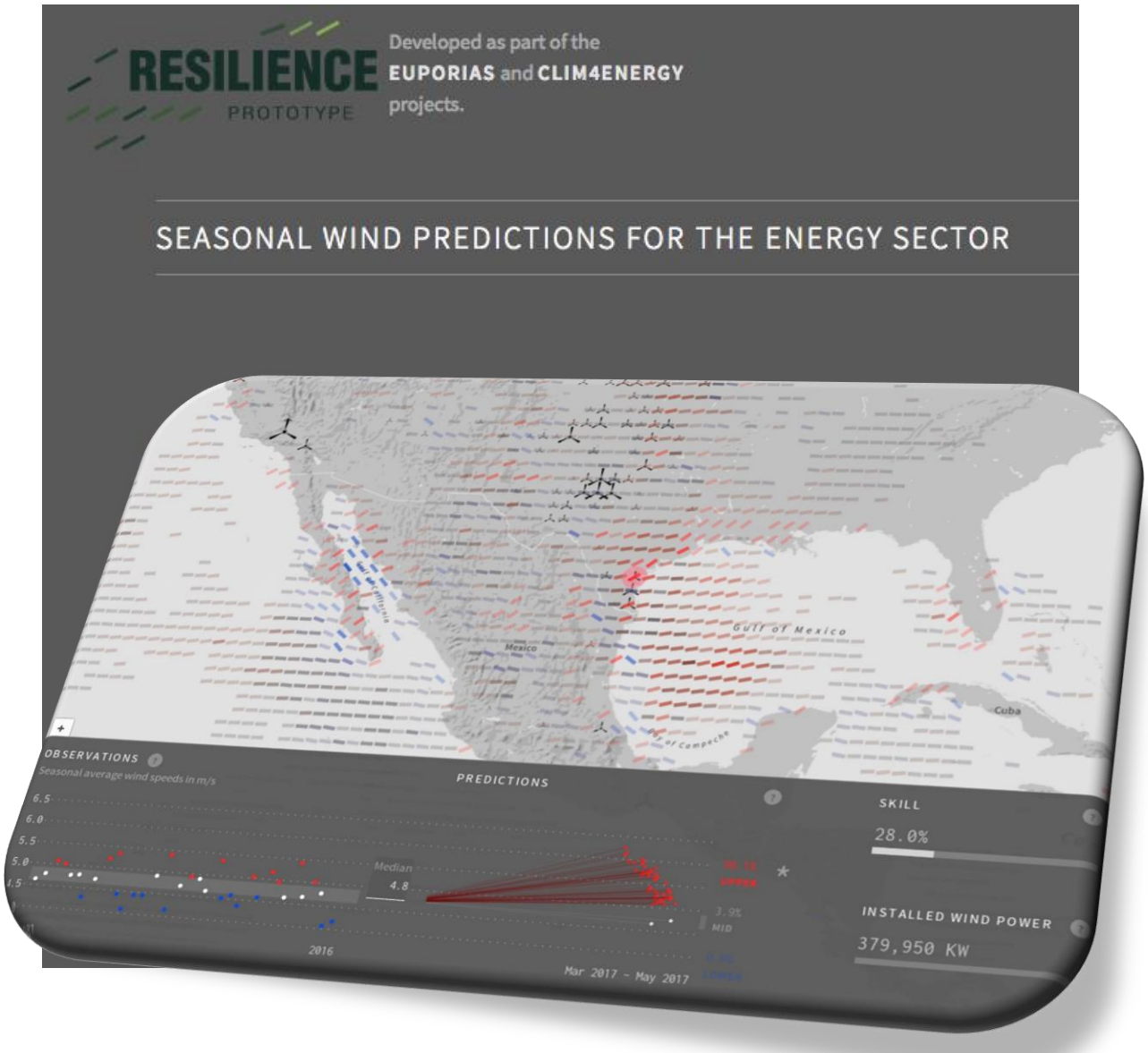
Advancing Renewable Energy with Climate Services

Under the current efforts to reduce greenhouse gas emissions within the context of a low-carbon development path, the share of renewable energy in the energy mix of countries is expected to continue increasing. Through appropriate partnership and stakeholders engagement, the application of climate information can provide useful support to energy management decisions and relevant policy-making to achieve optimal balancing of supply and demand as well as to drive behavioral changes in energy saving. ARECS (Advancing Renewable Energy with Climate Services) is an initiative that aims to provide useful and useable monthly to decadal wind and solar forecasts for the renewable energy sector, to help energy users understand and manage climate-related risks and opportunities.

ARECS could help you to:

Source: ***http://www.bsc.es/ESS/arecs***

RESILIENCE prototype

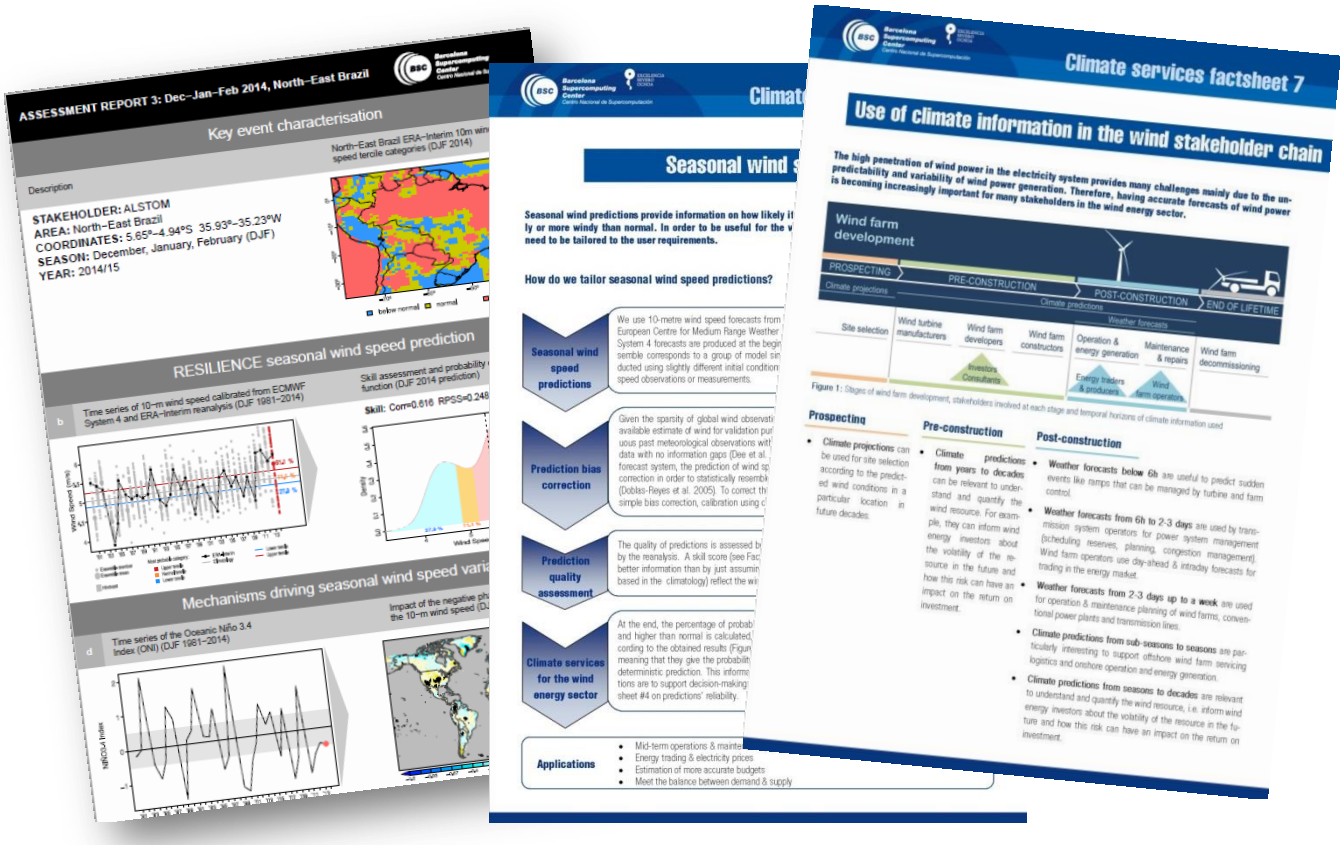


On-line visualisation tool for the wind energy sector – RESILIENCE prototype

- Joint development between scientists – designers
- Provides robust information on the future variability of wind (probabilistic predictions)

Source:
http://www.bsc.es/projects/earthscience/resilience/

Factsheets / Case studies

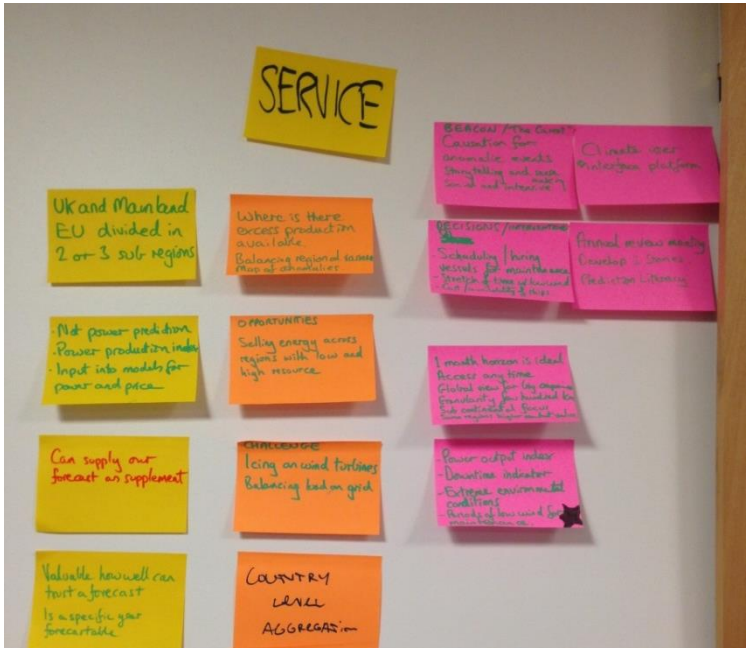


- **Two-page factsheets** describing different aspects of seasonal climate predictions that can be complex to understand by non-specialists.

- **Case studies** from the past that are relevant for particular industrial partners and learn how information on climate predictions would have been useful to anticipate particular past key events

Apps

Participatory approaches for user engagement (workshops, focus groups, interviews, surveys…)



Innovative ways of reaching users

The Weather Roulette app

Source: https://play.google.com/store/apps/details?id=es.predictia.weatherroulette&hl=es

www.bsc.es

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Thank you !

nube.gonzalez@bsc.es

EUPORIAS

NEW EUROPEAN WIND ATLAS newa

RESILIENCE

opernicus Europe's eyes on Earth

SEVENTH FRAMEWORK PROGRAMME

GOBIERNO DE ESPAÑA MINISTERIO DE ECONOMÍA Y COMPETITIVIDAD

The research leading to these results has received funding from the EU Seventh Framework Programme FP7 (2007-2013) under grant agreement GA 308291, the Ministerio de Economía y Competitividad (MINECO) under project CGL2013-41055-R and a contract for the Copernicus Climate Change Service implemented by ECMWF on behalf of the European Commission.